TROPICAL AGRICULTURE

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TROPICAL AGRICULTURE is published at the Imperial College of Tropical Agriculture, St. Augustine, Trinidad, West Indies, at the end of the third week of the month preceding the one of issue. Advertisement rates can be obtained at the College from the Editor, or from the Secretary of the College, 14, Trinity Square, London, E. C., England. The Editor will be glad to consider authoritative articles for publication. Correspondence is invited on all matters pertaining to tropical agriculture, science and development, which will be replied to, but not necessarily published.

TRADITIONS

THE Imperial College of Tropical Agriculture was formally opened in October, 1922, and since then it has not been infrequently remarked that because of its recent origin the institution must inevitably be lacking in traditions. From the limited aspect of the College as a new legal entity this is undoubtedly true; but from the wider standpoint of general history the case is entirely different In the first place tropical agriculture as a phase of human activity is itself as old as any. The planting of rice in China was, we know, a ceremonial observance 2800 B.C.; rubber, cacao and tobacco were cultivated and used by the Incas and Aztecs of tropical America also in very early times. In the middle ages tropical spices and other produce formed an important incentive to travel and adventure and discovery, in connection with which the names of Marco Polo, Vasco de Gama, Columbus, Hawkins and Drake are indissolubly tied. Nor must we forget the East India Company, chartered in 1600, and the great chartered Companies which later on operated in Africa and helped to lay the foundations of tropical trade and development.

But apart from these there are other great traditions in history of a more recent and pointed character, which, in spite of, or perhaps because of the immediate political position in England, must be referred to at some length. Students of British colonial history will remember that the economic relations between England and the Colonies fall into four fairly definite periods. In the first place there was the old Colonial System of the seventeenth and eighteenth centuries; then came the Colonial *laissez-faire* during most of the nineteenth century; next the re-action due to foreign competition towards the end of the nineteenth; and finally the period of Constructive Imperialism from 1895-1923. Into this latter period the establishment of the College of Tropical Agriculture falls naturally and consequentially. It was the period of Joseph Chamberlain—a statesman who deliberately chose the office of Secretary of State for the Colonies, hitherto considered a kind of secondary portfolio of the Cabinet, in order definitely to establish a closer connection between the self-governing Dominions and the mother country and to develop the resources of the Crown Colonies and Protectorates—a policy which he regarded as one of self-preservation for the whole. It was during this period that Imperial Preference became established; it was during this period that British Government Policy was definitely directed towards the financing of railways and public works in Africa; it was during this period that the British Government specifically encouraged the establishment of research institutes, like those at London and Liverpool, for the study of tropical health problems; during this period it was that the Government used its vast influence towards extending the scientific study of tropical agriculture. One of the outstanding features of Chamberlain's tropical administration was the establishment in 1899 of the Imperial Department of Agriculture for the West Indies as part of his great policy; and it was out of this Department that new Departments arose in other tropical countries and out of it that has arisen the Imperial College of Tropical Agriculture under the additional and specific encouragement of the great existing Imperialist, Viscount Milner. Thus the College is an outgrowth rather then an invention—an outgrowth with strong and vital connections. Nor must we, in considering its origin, overlook another and still more recent feature. The College is one of the few institutions which, located in one Crown Colony enjoys not only the support and patronage of others, but also those of Industries

and Universities in the United Kingdom. Its establishment is therefore braced by true Imperial co-operation which in itself is a tradition of no slight importance.

This and the traditions of its wider political origin must be augmented not only within the College itself but also by the work which the institution can do externally for the benefit of the tropics as a whole. Those who are familiar with the internal work of the College know that it is now proceeding along lines that are certain to lead to success, that every day new adjustments of policy are being made, all tending towards the achievement of those aims and objects for which the institution was established. But the real ultimate success of the College will depend not upon the success of its students within the College so much as upon their success in after life ; not upon the amount of research work done, but upon its quality and the degree to which it advances world science and world agricultural practice. The College in order to ensure these results should aim also at being a centre of constructive thinking, a centre for the formulation of sound and progressive policies fundamental to what is best in tropical development.

The Journal of which this is he first number may help to disclose what the College is doing along these lines. It should display in broad yet exact terms understandable by all classes of readers what tropical agriculture really means, the latest discoveries of research, the many problems that await scientific solution. It should in time become a connecting link between country and country by indicating one another's progress or difficulties. It should also become a bond of union between past students, some of whom, even at this early period, are already at work in the tropical world. Lastly it should be able to make it manifest that our College training is not of a provincial fact-absorbing character, but one of scientific principle and method such that students of ability can effectively make use of in any environment. If the College can achieve fundamental results such as these it will establish new traditions that will form a worthy counterpart to those of its history and origin which sprung, first in adventure, and secondly in the enlightened and progressive policy of Joseph Chamberlain and his worthy successors.

THE COLLEGE AND THE GROWER

Sir John Russell, f.r.s., d.sc.

The foundation of the Imperial College of Tropical Agriculture is an event of great importance in the development of tropical agriculture, and the wise decision to start a Journal will give to other workers in agricultural science and technology an opportunity of knowing the purpose for which the College stands and the work it hopes to accomplish. In this first number of the Journal it is appropriate to set out something of what has been done elsewhere and what the many well-wishers of the new College hope that it may achieve in the West Indies and the Empire.

In the first instance Agricultural Colleges and Experiment Stations have brought into agriculture much of the knowledge that has been gained by men working on wholly different subjects and for entirely different purposes. There is an enormous amount of knowledge in the world, but it is like the contents of a badly arranged warehouse ; no one quite knows where to find everything and no one can quite say for what any particular article can be used. The staff of the College seek among the stores of knowledge to find out what is likely to be of service in agriculture, a task which no agriculturist could possibly find time to do for himself. It was in this way that artificial fertilisers were first discovered by Lawes through the co-ordination of chemical and geological intelligence.

Another great purpose which Agricultural Colleges and Experimental Stations have fulfilled has been to find ways of overcoming difficulties which are causing serious trouble to growers. The history of plant diseases and pests is full of examples ; a crop is grown with great success and profit for a time, then comes the inevitable pest and takes first the profit and then often the rest of the crop. The experts set about their work in two ways ; they study the pest as fully as possible and thus discover its strong and its weak places. Then they try to find ways of taking advantage of its weaknesses and so keeping it in check. At the same time they try to find varieties of the crop which are less susceptible to or perhaps even immune from the attack of the pest.

The third and perhaps the greatest purpose which a College or Experimental Station can achieve is to discover and show to the grower something of the wonderful interest of the work on which he is engaged. Agriculture is not simply a business ; it is a mode of life, and no one can get the most out of it for himself or for others unless he is really interested in it for its own sake. It is impossible to build up strong tropical communities if the growers are simply exploiting the soil to make money and have no interest in their work beyond the pounds, shillings, and pence they can get out of it. If only he knew it, the tropical agriculturalist has before his eyes a wonderful pageant of Nature beyond the power of the most vivid imagination to invent or the most powerful intellect fully to comprehend. But the tragedy is that so few realise it. How many growers know that when they plough green manure into the land they are setting in train some of the most remarkable processes in Nature ? And if they only did know something of what was happening (and although the details are infinitely complex, the broad outlines are astonishingly simple) what an interest it would give to their daily work, and indeed to their whole lives.

These are some of the purposes which the great Agricultural Experimental Stations and Colleges have achieved elsewhere, and all who are interested in tropical agriculture will hope that the new College now established at Trinidad will do as much and more, especially in the direction of fundamental research.

AIMS AND WORK

SIR FRANCIS WATTS, K.C.M.G., D.SC.,

IT is generally recognized that the practice of agriculture has been considerably advanced during recent years by the more systematic training of those engaged in it. This improved training has come through various agencies, such as Agricultural Colleges and the inclusion of agricultural education in the courses of study of a great number of the Universities ; much has also been done through the influence of Institutes for Agricultural Research, Experiment Stations, Agricultural Societies and kindred organisations. The activities of the latter agencies have made evident the value of the systematic instruction given in the Universities and Colleges, for it has become apparent that a sound basis of scientific knowledge best assures progress and good practical work ; hence the Agricultural Colleges and the agricultural courses in the Universities are being more and more frequented by those who intend to engage in agricultural work as a means of livelihood

These developments have led to demands for training in relation to tropical agriculture and this demand is accentuated by the increasing importance of the tropics as the sources of supply of commodities which have become essential to the daily life and industry of the vast communities living in temperate regions.

The special conditions attending agricultural work in the tropics and the nature of the crops grown, make it essential for those engaged in tropical agriculture to acquire the requisite skill and experience within the tropics themselves and in intimate contact with tropical crops and conditions. But hitherto few institutions have existed where a student could acquire systematic instruction in matters relating to tropical agriculture ; most of those engaged in producing within the tropics those important commodities such as sugar, cotton, cacao, tea, rubber which supply the world's markets have had to acquire their knowledge and experience on the plantations, much as the farmers of temperate regions were obliged to do in former days ; they too are beginning to enquire why facilities such as are so advantageous to farmers of temperate regions which are receiving increasing recognition at their hands, should not be available in regard to tropical work.

It is with the object of providing education and guidance of the kind asked for in relation to tropical affairs that the Imperial College of Tropical Agriculture has been established.

The College, which has now entered upon its second year, carries on its work in several directions. As its prospectus states, its object is to afford general instruction in tropical agriculture, to give opportunities for thorough training in the science and practice of the subject to those intending to become tropical planters, investigators or experts in different branches of agricultural science or technology, and at the same time to provide facilities for the study of tropical agricultural subjects on the part of graduates from other Universities and Colleges who desire to acquire knowledge of these subjects in tropical surroundings. To this end the College offers a three year's course in general agriculture, leading to a Diploma ; it affords facilities for study of particular subjects on the part of post-graduate students and it is prepared to afford facilities for research.

The three year's Diploma course is of a broad ; general nature intended to afford a sound basis of education in agricultural matters. At the same time special attention is given to the methods of growing, handling and marketing the more important tropical crops, the cultivation of the soil under tropical conditions and the many special problems connected therewith, the management of labour, the general equipment and management of plantations, and, in a general sense, to give a man a good all-round training.

It is obvious that a three year's course of instruction cannot provide the intimate experience acquired by long years of work on a plantation and cannot turn out managers of plantations of full experience, but it can give those entering upon agricultural work a bet er start and provide young men who should prove of more value to employers than untrained men who have to acquire their training while carrying out routine duties.

In the second and third year of the course the work is differentiated to meet the needs of those requiring training in regard to particular sciences and industries ; thus, after the preliminary training in scientific fundamentals, the students are given opportunities of specialising in regard to various aspects of such crops as sugar, cacao, coconuts, bananas, various fruit crops, rubber and a variety of others, care being taken to develop a wide outlook at this stage.

In addition to affording a groundwork for study on the part of those expecting to engage in general plantation work, the three year's course should afford a good general training for those who wish to obtain appointments in the various Agricultural Departments which now exist throughout the tropics, and it is hoped that these Departments will co-operate with the College by informing it of their requirements, so that any special lines of work may be given attention.

The general course is calculated to be a useful and sound training for those who desire, by continuation of their studies, to become qualified to undertake duties in professional work, such as

plant pathology, entomology, mycology, agricultural chemistry, plant breeding; a combination of general and post-graduate studies at the College offers unusual opportunities and facilities for acquiring this training.

The opportunities for post-graduate study call for special mention. Situated as the College is, within the tropics, in an island which has many of the featu es of the South American Continent, which it closely adjoins, and in intimate touch with an unusual variety of tropical industries, the College offers admirable opportunities for giving instruction to post-graduate students in connexion with specific industries, particularly the production of sugar, cacao. coconuts, cotton, fruit and food crops and many others and also for studies embracing botanical, mycological, entomological, chemical and other interests, either in relation to industries, or in the direction of abstract scientific investigation.

RESEARCH ON TROPICAL CROPS

PROFESSOR S. C. HARLAND, D.SC.

An increased amount of nterest in research has been displayed in recent years by practical agriculturists on the one hand and manufacturers on the other. A tendency to regard research as an interesting adjunct or side line to a business has, in some industries, passed into a phase in which the results of research, organised on a big scale, are regarded as constituting the difference between success and failure.

In the Lancashire Cotton Industry for example, the state of affairs is as follows: trade dealing with the coarser types of cotton is probably destined to pass into the hands of countries with cheap labour, and the trade in fine cotton goods, such as those manufactured from Egyptian, long Staple Upland and Sea Island must expand concurrently as the coarser end disappears. The grave competition which the finer class of cotton goods meets from foreign countries must be countered by research. Further, research must be deliberately planned to advance knowledge of the fundamental principles on which the current practices in the industry are based. The keenest minds in the Lancashire Cotton Industry are of the opinion that research is the only alternative to disaster, and have given pointed expression to their views through that wisely conceived organisation, the British Cotton Industry Research Association. A survey of the already extensive literature which has been published by the Body during the past two years leaves no doubt that the cotton industry has pursued a wise policy which is destined to have a far-reaching effect not only on the cotton industry but on the general relations existing between men of science and manufacturers.

The manifold industries carried on in the Tropics under the general name of Agriculture stand in just as urgent a need of research as the industries in England which employ the raw or partly manufactured material. If the cotton, rubber, cocoa and sugar industries in England feel the need of research for improvement of quality or more economical methods of manufacture it is evident that the need for research exists to a similar extent on the growing side even though it is not so urgently felt.

It must not be imagined that the investigations on cotton and other crops which have hitherto been carried out in the tropics are decreased or minimised by the above statement. Much valuable work has undoubtedly been done; but it has mostly been of the "trouble-curing" type. Some particular insect or plant disease has given trouble and the Entomologist and Mycologist have been called in to counsel remedies—very often successfully. But what must be emphasised is that there has been no organised attempt made with any tropical crop on a sufficiently large scale to accumulate fundamental knowledge which will produce certain economic results as its natural outcome. Indeed, the labours of those who have worked on tropical crops have in the past been carried on under great difficul ies and the value of them largely discounted because fundamental knowledge was lacking and could not be obtained. Even when research has been embarked on it has often suffered because those responsible for its direction have been ignorant of the type of research worker to employ. Twenty years ago chemists were fashionable: if anything went wrong with a crop it was supposed that a chemist should be called in to analyse the soil, or the plant, or both. Mycologists and Entomologists then came in and did valuable work in the control of pests and diseases, but where a really serious disease cropped up like the rust disease of wheat or the wilt disease of cotton the mycologist was unable to suggest economic measu es of control. It was left to the plant breeder to perform this function by isolating new varieties immune to the disease. An analogous state of affairs has existed in England in Industrial research. Chemists have been employed on research problems which could be adequately solved only by physicists, while the part which could be played by botanists in pursuing an organic raw material beyond the plant to the finished article has been almost unrecognised.

Broadly conceived, therefore, research on tropical crops must embrace not only mycology, entomology and chemistry but should include genetics, plant physiology, physics, chemistry of colloids, bio-physics, soil science, and bio-mathematics.

It may be emphasised that there is this difference between research on the manufacturing and research on the agricultural sides. In the former real advances in fundamental knowledge of such a type as will be useful to industry are necessarily slow, because most industries are already highly specialised in methods of manufacture, and many keen wits are daily devoting themselves to improvement in technique or type of machine.

In the latter much fundamental knowledge has already been procured with crops grown in temperate climates which is capable of immediate and profitable application to practically any tropical crop. The general principles involved in plant improvement are well known to every serious student of plant-breeding and only need employment on a sufficiently large scale to bear immediate economic fruit.

The rubber growers in the East are already alive to the great possibilities of a wide and comprehensive research scheme, and it now remains for the growers of other tropical crops to follow in their wake.

TROPICAL ENTOMOLOGY

PROFESSOR H. A. BALLOU, M.SC.

The application of scientific knowledge and scientific methods to the everyday affairs of life has resulted within the past few years in developments which were impossible to foresee, and in the Tropics, the benefits from the biological sciences have in no field of work been more striking or more beneficial to man than in that of entomology.

The results obtained and experiments effected have resulted in the development of an extensive literature. This can be divided into literature devoted to the special subjects related to insects in connection with practical affairs, as distinguished from the literature of that section of entomological science which deals purely with the insects themselves.

As is well known, the association of insects, as carriers, with the serious diseases of man and domestic animals has opened up lines of investigation which have already revolutionised life in the tropics and made possible constructive work, which would have been impossible without entomological knowledge.

This work may be said to have started with the discoveries about thirty-five years ago of the relation between the ordinary cattle tick and Texas fever, one of the most deadly diseases.

This disease, which took a very heavy toll in the way of sickness and death among the range cattle in Texas, was found by Smith and Kilbourne to be the direct result of tick attack. Ticks had long been known as cattle pests which caused by their habits of parasitism emaciation, weakness, and death, but it was not until they were proved o be carriers of organisms causing Texas fever that their real importance was recognised.

The striking feature of the method of the transmission of the disease from the sickly to healthy animals was found to be that the tick which had been parasitic on the body of an animal suffering from the fever, did not itself carry the disease to the healthy animal, but that the eggs were deposited on the ground by the female tick which had dropped from the body of the diseased host. These eggs produced infected larvae which when they found a suitable host were able to transmit the disease.

The application of this knowledge has resulted in large areas being freed from the cattle tick and Texas fever. The use of cattle dips and sprays for the direct destruction of the ticks has been found very useful in this connection, but the greatest benefits have been derived from a system of rotation of pastures — a method depending on a knowledge of the life history of the tick.

Shortly after the discoveries in connection with the cattle tick, Manson and Ross working in India made the epoch-making discovery of the relationship between the Anophiline mosquito and malaria in man. In this relationship the mosquito sucks the blood of the malaria-bearing host and becomes, after a short interval, capable of inoculating the disease parasite into a healthy person.

A few years later the relation between yellow fever and mosquitoes was established by direct experimental investigation in Cuba. The American Army Surgeons, Reed, Carroll, and Lazear proved, firstly, that yellow fever is not caused by miasma or night air, nor conveyed by contact of the healthy with the sick person, nor by contact with soiled bedding or clothing; it was definitely proved by experiment that yellow fever was communicated to healthy persons by the bite of a mosquito, and one member of the party who voluntarily subjected himself to the experiment contracted the fever and nearly died of it.

Immediately following on these discoveries careful studies were made of the habits and life histories of these insects with a view to reducing their numbers and controlling outbreaks of these two diseases. Knowledge was gained of their breeding places, and it was found that these in many instances could be done away with, and in others that treatment could be applied which prevented the development of the mosquitoes. This has led to many previously uninhabited regions of the tropics being rendered comparatively healthy.

Naturally the control of these diseases of animals and man, particularly malaria in man, has had a direct bearing on tropical agriculture. In many localities it has been possible to develop valuable agricultural resources through rendering conditions fit for Europeans and by increasing the general vigour of labour. In this work one must refer to the valuable activities of the London and Liverpool Schools of Tropical Medicine, and of the great Foundations in the United States of America which are doing so much in connection with Ankylostomiasis.

The insect pests of the crops which form the proper province of agricultural entomolcgists have attracted attention from the most ancient times. Many remedies and control measures have been tried, from incantations in the past, to the scientific application of exact knowledge at the present day.

Although the relation between insect pests and the injury to crops has long been recognised and attempts made to control pests and reduce the

losses resulting from their attacks long before the importance of insects on the medical side was recognised, there have been no triumphs in agricultural entomology so complete and so spectacular as some of those already mentioned in connection with the welfare of man and animals. In point of fact, some of the most important of the problems in agricultural entomology still await satisfactory solution. On the other hand there are instances where much has been achieved.

In connection with certain leaf eating caterpillars the direct use of poisons has been found to give satisfactory results, and in the case of scale insects which attack valuable trees, methods of fumigation with poisonous gases have made it possible for man to reduce very greatly the losses from the attacks of these pests.

In the case of certain plant feeding bugs, instances have been discovered in which the feeding of the insect is very closely associated with the transmission of fungoid diseases which seriously affect the host plant. The cotton stainers of the genus Dysdercus feed upon the developing bolls of the cotton plant. The very delicate thread-like mouth-parts are inserted into the tissue within the boll, and at the point of these punctures disease develops which destroys the cotton and cotton seed. If these punctures and infections are numerous enough the entire contents of the cotton boll may be so njured as to render the lint quite worthless. In this case it is the disease that causes the injury and the cotton stainer which must be controlled in order to prevent that injury. In several of the West Indian Islands cotton stainers which have been abundant and troublesome have been controlled to a very large extent by the destruction of the uncultivated food plants in connection with the enforcement by law of a close season.

In the pink bollworm of cotton we have another agricultural problem of great importance.

The adult insect is a small inconspicuous moth. The caterpillar spends its life within the boll finding the major part of its food in the cotton seed. At the end of the cotton season certain of these caterpillars are able to enter into a dormant or resting condition.

In this resting condition the insect remains for long periods, as much as two years or more, and it is this resting stage which makes the insect particularly dangerous and difficult to deal with.

An insect pest, also attacking cotton, which has so far got the better of the economic entomologist is the Mexican boll weevil which invaded the Southern United States from Mexico about thirty years ago. In spite of all the efforts of entomologists and agriculturists to prevent its spread, this insect has progressed steadily from year to year until at the present time the entire cotton belt of the United States of America has been invaded. Every device for insect control that gave any prospect of being successful has been tried, and nothing like complete control has been achieved. A number of natural enemies, both predaceous and parasitic, have been discovered and studied, but so far none have appeared capable of exercising any satisfactory control over this pest.

There is no doubt that the control of insect pests on plants often depends on a definite relation between the plant and the insect. In the case of many insects, healthy plant tissue does not invite attack—that is to say, such tissue does not appear to be a suitable medium or to offer favourable conditions for the feeding and breeding of the insect.

Much remains still to be learned of this extremely important phase of entomology, and it seems likely that in the tropics, at least, many agricultural pests still have to be studied with reference to their relation to the condition of the plant.

TRINIDAD CACAO

PROFESSOR W. R. DUNLOP.

Industry has its economic maladies just as plants and animals have their biological ones, and this is particularly true of the industry of tropical agriculture. History provides many instances. One has only to recall, for example, the plight (in contra-distinction to the "blight") of the West Indian sugar industry in the nineties, and the more recent depression of the rubber industry of the East. Both were occasioned by political and economic circumstances, and were remedied by political and economic action: the first depression by the abolition of bounties and more efficient central factory production; the second by an elastic restriction of production rendered possible by legislation and the commercial co-operation of large interests.

One of the latest maladies in tropical agriculture —and one of a much less impersonal type—is to be seen in the condition of the West Indian cacao industry. The causes of this condition are almost entirely of a psycho-economic nature and they are therefore worthy of careful consideration by everyone concerned with the administrative side of tropical agriculture and development.

In the first place, it is Trinidad—by far the most important of the West Indian cacao-growing colonies and the fourth largest cacao-producing country in the world—that is the most affected, and it is in this Colony that the malady may be studied best.

Briefly the history of the condition is as follows. Some thirty or forty years ago, when the rapid establishment of cacao estates began, it was the recognised local custom to acquire suitable Crown land, freehold, at the usual moderate price, and for the owner to develop a small part of it himself, and most of the remainder by means of the contract system whereby the contractors, usually natives, brought the cacao into bearing and were then paid for the established plantation on a more or less arbitrary basis of valuation of about 4s. per tree arrived at by capitalising the return to be expected

under conditions existing at the time. In order to carry out this development and make payment to the contractors, which involved in many cases thousands of pounds, the owners of the estates borrowed money on mortgage. Subsequently, also, in bad years, further mortgages might be incurred. The ultimate result was that the majority of the cacao estates in Trinidad became heavily encumbered; but since the good price of cacao and the bountiful productive powers of virgin soil brought in a large return, it allowed of the payment of a high rate of mortgage interest without inconvenience; which in its turn provided a profitable investment to the mortgagee, and both parties being satisfied, neither had much inclination to come to any settlement in respect of the principal involved.

This state of affairs proved effective while the necessary economic conditions for making it so were satisfied. But when in 1920 after a bad climatic season the price of Trinidad cacao fell 50 per cent. of what it had been before the war, cacao planters found themselves financially embarrassed. This was aggravated by the fact that the output per acre had been growing less and less which, in the last few years has continued, owing to connative and financial deficiencies in respect of running the estates on sound agronomic lines.

Now while the pre-war level of prices of cacao are not essential for the profitable production of cacao in Trinidad on a well-managed, productive and unencumbered estate, the present price level of some 8 cents per lb. (in New York or London) is certainly very near the limit for successful enterprise. This phenomenally low price is attributable to the enormous increase of low-cost cacao in the Gold Coast (which of course, in common with the West Indies has enjoyed Imperial preference), and to the collapse of the Central European markets especially Germany, who, before the war, consumed as much cacao as the United States did at that time. Contributing causes have been the gradual improvement in quality of much of the Gold Coast cacao and also definite changes in formula in the larger chocolate factories in Britain and America, to make use of this cacao as the basic grade for general consumption.

As to whether the price of cacao in general will increase or (what would be equally beneficial for the West Indies) the premium which Trinidad estates' cacao should command—does not come within the scope of this article. Action is being taken in order to try to bring about a rise in price or else to circumvent the present low level if it persists. Trinidad cacao, however, from the point of view of grade occupies a rather precarious position. Marketing results hoped for may, or may not, be achieved. They are at any rate not likely to be achieved immediately, and it is the immediate present that is important in a critical condition such as exists in Trinidad to-day.

At the time when the crisis began—in 1920—the Government, in order to help the basic industry of the Colony, introduced an Agricultural Relief system of financial aid, and lent money to encumbered estates claiming in doing so first mortgage (even on estates so encumbered). In addition a moratorium was passed making it illegal for mortgagees to foreclose unless payment of interest was withheld beyond a certain time. This latter action was primarily taken to prevent the withdrawal of foreign loans on cacao which in Trinidad are considerable and amount to several hundred thousand pounds. Both moratorium and relief, which are still in operation, are likely to be lifted this year. But unless a sudden and substantial improvement takes place in the marketing aspect, the final result cannot be other than a complete revolution in ownership and industry—which, while conferring hardship and perhaps ruin on many, will probably in the long run be the best thing for the Colony.

It is of course true that the authority of the Colonial Office has been obtained for the establishment of a permanent Agricultural Bank. This institution will lend public money in the form of mortgage loans on an amortization basis, and will advance money also against crops. But even if the capital of the Bank were large enough—which it is not—it could scarcely revivify the cacao industry in its present condition. Estates carry loans against valuations fabulously fictitious at the present time. Indeed much of the present trouble lies in the circumstance that valuations were made on the basis of market prices for cacao. This has no meaning in the sense of intrinsic security for, *reductio ad absurdam*, if the price of cacao falls for a period of years below the cost of production a cacao tree is commercially valueless and the property becomes in theory (and in reality) so much bush covering an impoverished soil. The estate—except for its buildings and communication facilities—has not the value of good Crown land. Hence there is no real security in a cacao estate mortgage, and the valuations of the past in Trinidad have been nothing more than arbitrary estimates of possible revenue.

In conclusion it would appear that the conservation of the industry depends upon an economic adjustment being made between higher yields and lower cost of production. Lower costs can be effected immediately by the elimination of mortgage interest (foreclosure) and reform in management. The specific nature of the reform in individual cases can only be determined by an analysis of the economic structure of each estate by means of cost accountancy and statistical methods. Once estates have been re-started on a sound basis the general adoption of a cost accountancy system involving cost valuation and depreciation, capital and private and reserve accounts, will be the best ethical as well as economical safeguard to future progress.

THE TROPICAL WORLD

SUDAN.

At the sixteenth ordinary general meeting of the Sudan Plantations Syndicate at Winchester House, London, on November 8th last, Mr. F. Eckstein, Chairman of this Company, whose land development operations form the basis of the greatest of the British cotton growing schemes, was enabled to make a most encouraging and inspiring report. Referring to his recent visit to the Sudan Mr. Eckstein called attention to the magnitude of the 300,000 acres scheme at Barakat, to the influx of people from Nigeria into the Sudan and to the satisfactory yields of cotton at the principal stations. We notice however that cotton suffered heavily from thrips at the station at Hosh. One most pleasing features of the year's operations was the concession of freehold tenure by the Sudan Government as an indication of its appreciation of the Company's operations.

SIERRA LEONE.

A feature of the agricultural and plant industry administration of Sierra Leone is the amalgamation of the former agricultural and forest departments under one head to constitute a Land's and Forest's department under a Commissioner. This arrangement, which has advantages in undeveloped tropical countries was suggested a few years ago as likely to meet existing needs and requirements in the Central American Colony of British Honduras. The first report of the Sierra Leone department was for 1922 and this is worth perusal both from the point of view of its special administrative outlook and the large amount of detailed information whiich it contains. Mr. M. T. Dawe, the Commissioner, and Mr. G. W. Scotland the Director of Agriculture, are familiar with conditions in South America and the West Indies as well as with those of West Africa.

THE GAMBIA.

Mr. A. J. Brooks, who was appointed Director of Agriculture in 1922, and proceeded to the Protectorate from St. Lucia, West Indies, the same year, has recently presented an excellent report on the Gambia's agricultural position and requirements. Mr. Brooks recommends the establishment of an organized Department of Agriculture, which would necessarily have to be on a modest scale at first on account of the at present strained financial position of the Protectorate. The first aim of the Department, if it is established, as it certainly should be, will concern the improvement and stabilization of existing industries. Ground nuts, by far the most important export, are widely affected by fungoid diseases and poor methods of production, and better methods are also needed, according to Mr. Brooks, to prevent the shrivelling of nuts and adulteration. The Department will also give attention to increasing the local food supply, especially rice which in the Gambia is largely cultivated by women. Recommendations are also made with reference to the retention of 'strange farmers' chiefly natives from neighbouring French territory who come seasonally to plant ground nuts. Mr. Brooks suggests a land settlement for this purpose. If the Department materializes on the lines laid down, the head office will be located on a portion of the land belonging to the Hon'ble Sam. J. Forster, on the Bathurst-Cape St. Mary road, three miles distant from Bathurst the Capital which, as most people know, stands on an island near the mouth of the great river from which this extensive river-side territory takes its name.

It is interesting to remember that the Gambia is the oldest British settlement in West Africa and that after the erection of Fort James in 1662 it became the chief centre of trade until the subsequent development of the Gold Coast and Nigeria.

SUMATRA.

Dr. Vischer has lately called attention to the amount of native-owned rubber in this island—an island which is more than twice the size of British Malaya, to the south-west of which, in the Indian Ocean, it is closely situated. It is estimated that the natives own some 50 million trees, which, under good management, should yield 80,000 tons of rubber per annum—an amount quite capable of influencing the world's market price. This might be important at times when attempts are made to raise the price of rubber by restriction of Company operations. Influence of this kind was actually experienced in the initial stages of restriction in the Federated Malay States in 1920. It is therefore important, says Dr. Vischer, that statistical data should be obtained and studied in respect of native cultivations. Regarding the quality of Sumatra native rubber it would appear that for the most part it is equal to off-quality smoked sheet.

FORMOSA.

Dr. T. Baty in a recent issue of the *Contemporary Review* gives us an attractive picture of this far eastern centre of sugar and camphor production. " If a European were suddenly set down in Taihoku and invited to guess where he was, Formosa is the last place that would occur to him. We think of the island as it was thirty years ago—a 'nooks-hotten' place of sugar shanties and hovels fringing the virgin mountains... The great solid palaces marble-lined, the well paved roads, the villas and hospitals. Little is known in the West of the energy and enterprise with which the Japanese have set to work to create modern conditions in their new possessions." Askao (now called Heito) —one of the smaller towns, is an important sugar centre with the central factory of the Formosan Sugar Company. The big camphor works are at Taihoku, and travelling into the hills by the Arisin scenic railway one sees the forests which are the source of so much wealth.

Formosa has more than half a million acres of rice lands. The first crop for 1923 was nearly 13 million bushels.

BRITISH WEST INDIES.

The forthcoming Agricultural Conference to be held in Jamaica this month under the presidency of Sir Francis Watts is an event of importance. The Conference has been called by the Secretary of State for the Colonies and representatives of the scientific staff of the Imperial College of Tropical Agriculture will attend. The subjects on which papers will be read include the banana industry, the sugar industry and the cacao industry. The proceedings at the Conference will be published in due course. In making reference to bananas it may be mentioned that a good deal of attention has been given recently to the extension of the industry in the British West Indies, but up to the present certain obstacles have prevented developments taking place in the smaller islands. Some of these difficulties will no doubt be discussed at the Conference in Jamaica.

Another notable West Indian event will be the laying of the foundation stone of the new building of the Imperial College of Tropical Agriculture in Trinidad on the occasion of the approaching visit of Sir Arthur Shipley, who, together with Capt. Hill, F.R.S., (Director of the Royal Botanic Gardens, Kew) and Mr. Algernon Aspinall, C.M.G., are spending some weeks in the Caribbean colonies this winter.

TANGANYIKA.

Much attention continues to be given to cotton both by the Government and the Empire Cotton Growing Corporation in this territory. Auctioning native grown cotton at markets conducted by Agricultural Officers has ensured a fair price to the native grower and a return for the trouble taken in grading. The grower receives cash on delivering the cotton and has no direct communication with the buyer. It is interesting to note that in the Mwanza and Bagamayo districts the output of cotton increased by 279 per cent. and 725 per cent. respectively in 1922. Coffee growing is being encouraged in the Moshi district by providing nurseries of well grown plants, instructing the native and assuring him a good market for the coffee produced.

The native tobacco (*Nicotiana rustica*) is being experimented with in order to produce leaves with a high nicotine content useful for the manufacture of insecticides.

It may be mentioned that the East African Territory of Tanganyika lies between Lake Victoria Nyanza on the North, and the Rovuma River on the South, and extends from the Indian Ocean to the shores of Lakes Nyassa and Tanganyika from which it takes its name. Its total area is about 365,000 square miles. It was formerly part of German East Africa, but by the Treaty of Versailles the mandate for its administration was given to England. The Director of Agriculture is Mr. A. H. Kirby, B.A., who was formerly in the Imperial Department of Agriculture for the West Indies.

CEYLON.

Ceylon like other tea-growing countries benefitted last quarter by the boom in tea. Amongst agricultural developments, the planting of wattle for wind belts and green manure purposes on tea and cacao estates is being encouraged, and also for timber and fuel purposes. A five year old tree has yielded 54 lb. of dry bark containing over 31 per cent. of tannin. Most of the tannin for Ceylon tanneries comes from India and it is considered that the material can be produced much more cheaply locally. A large amount of attention is being given to increasing the Colony's food production owing to India having limited its supply of rice. Another line of agricultural development in this Colony is sisal cultivation which is being actively pushed by the Ceylon Hemp and Produce Company. In recent months there has been interesting news regarding coconuts. The results of the Chilaw experiments have been published while at an important meeting of planters the deep planting instead of the shallow planting of nuts was definitely agreed upon. Concerning educational matters, the Ceylon Government has sanctioned the establishment of a "Ceylon Journal" the first number of which contains articles on botany, zoology, geology, physics, fisheries, medical science, and archaeology.

Agricultural shows will be held in the following divisions of the Matale district in 1924: Matale South, during July, at Matale; Matale East, during March, at Rattota; Matale North, during July, at Matale. Considerable interest has been aroused in Ceylon in regard to Dr. Willis's new botanical work "Age and Area." Dr. Willis was formerly at Peradeniya before going to the Botanic Gardens, Rio de Janeiro, which he left a few years ago to carry on research work at Cambridge.

EAST AFRICA.

Though somewhat belated we have, on account of its importance to record the formation of the Joint East African Board which has been established in London. The objects of this important body are to bring about co-operation and uniformity in respect of matters of administration and policy in Kenya, Nyasaland, Uganda and Tanganyika and to create a liason between those Colonies and Protectorates and commercial interests in Great Britian. Apparently the Board is being established with similar functions to those of the oldest body of the kind under consideration, namely, the West India Committee. Like that Committee, the East African Board is not an Association for direct profit but an organisation for protecting the interests and promoting the welfare of East Africa. It is not intended that the Board shall in any way supersede or overlap the function of any organisation existing for the purpose of promoting special interests (*e.g.* the Empire Cotton-Growing Corporation, the London, the Liverpool and Manchester Chambers of Commerce, the East African Producers' Association and similar bodies), but that it shall endeavour to unite all interests in East Africa in support of a common policy of development.

LIFE IN THE SOIL

SIR ARTHUR SHIPLEY, G.B.E., LL.D., SC.D., F.R.S.

Master of Christ's College, Cambridge;
Chairman of the Governing Body of the College.

[*The following article forms part of a chapter in a book by Sir Arthur Shipley entitled "Life," which is being published by the Cambridge University Press It deals with the soil of a temperate climate, but the main principles on which soil is built up, and its reaction on vegetation and animal life is, within limits, the same all over the world.*]

The ideal soil is not composed of sand or clay or humus alone, but contains a proper proportion of all three: the sand to ensure porosity and a proper circulation of water, the clay to lend firmness and to prevent too rapid evaporation, and the humus to provide plant-food rich in nitrogen. The average grains making up a soil are about two and a half times as heavy as an equal volume of water, and the weight of a cubic foot of soil varies from about 80 to 105 lb., the sandy soils being the heavier and those rich in humus the lighter. In ordinary soils from one-third to one-half of the volume is *pore-space* which may be occupied by air or water according to circumstances, depending largely on rainfall and the effectivenes of the drainage. The total surface area of the particles in one cubic foot of a light loam is estimated at about an acre. Each granule or particle of soil being surrounded by a pore-space, excepting at those points at which it is in contact with other particles; it follows that the air spaces, however contorted in size and direction, must form continuous tubes or passages which traverse the soil in all directions.

The organic matter has two sources. One is decayed plant and animal life, which rots away and disintegrates in the soil. That which has been built up from the soil is returned to it as decaying matter, "dust to dust." This decay is associated with a certain amount of heat, as one sees in a fermenting manure heap; and, in fact, as much heat is given off as would be given off if the decaying material were burned, but of course the process is much slower. It is this decaying organic matter that helps to make life possible in the soil.

Garden soil is as teeming with life as is a great city. It is recorded that Prince Bismarck once said to Lady Randolph Churchill: "Have you ever sat on the grass and examined it closely? There is enough life in one square yard to appal you."

It has always seemed to me a strange thing for the Prince to have said. To begin with, throughout his long life he had shown but an imperfect sympathy with the lower Invertebrata, and then, again, he was a man not easily appalled: but the saying is perfectly true. There are millions of bacteria performing various functions. There are millions of unicellular animals of an amoeboid and flagellate nature creeping in and out the interstices of the soil. As a result of 365 counts, made on consecutive days, of the bacteria and of six different species of protozoa in a natural field soil, it became clear that from day to day the numbers varied greatly and that this variation had no connexion with the weather. Fortnightly averages showed certain seasonal changes, and the numbers of both bacteria and protozoa are greatest towards the end of November and smallest during February. The seasonal fluctuations resemble those of many aquatic organisms and are independent of rain-fall and temperature. There is a noticeable relationship between the numbers of certain *Amoebae* and of the bacteria. More *Amoebae* mean fewer bacteria. The former eat the latter.

It is easier to kill *Amoebae* than to kill bacteria. By an accident at Rothamsted it was discovered that certain soil heated to 98 degrees oxidizes more rapidly than normal soil and in it bacteria were increasing at a more rapid rate than usual. At the same time nitrates and ammonia in the soil increased very much more rapidly. There is evidently some living organism in the soil which consumes bacteria and was destroyed at 98 degrees Fahrenheit while the bacteria persisted. By using such partially sterilized soil it is claimed that a crop of tomatoes which normally produced 32 to 35 tons per acre could be increased to 80 or 90 tons.

Minute round-worms are creeping and wriggling through the soil. Some of these spend their whole life there, others only their larval existence, whilst others return to the soil only when mature. A typical example of this is the Round-worm which causes disease in adult grouse. It leaves the alimentary canal of the bird with the droppings, produces its young on the soil, and the larvae make their way to the heather, and slowly wriggle up to the heather-buds which form the favoured food of the mature grouse. With this food they pass into the alimentary canal of the game bird, become adult, and set up fresh trouble in the bird's intestine. It is difficult for the layman to grasp what is going on in and on the soil and on the plants which it supports. Suppose we could by means of a gigantic lens magnify a square yard of a grouse moor one hundred times. The heather plants would be as tall as lofty elms, their flowers as big as cabbages, the grouse would be about six or seven times the size of Rostand's "Chantecler" at the Porte St. Martin Theatre. Creeping and wriggling up the stem and over the leaves and gradually yet surely making their way towards the flowers would be seen hundreds and thousands of silvery-white worms about the size of young earthworms. Lying on the leaves and on the plant generally would be seen thousands of spherical bodies the size of grains of wheat, the cysts of the *Coccidium* —a protozoan parasite which destroys the young grouse chick—and on the ground and on the plants, as large as peas would be seen the grouse tape-worm eggs patiently awaiting the advent of

their second host. It is perhaps a picture which will not appeal to all, but yet it represents what unseen and unsuspected is always going on on a grouse moor.

Then there are innumerable insects, chiefly in the caterpillar stage, which crawl through soft earth and do infinite harm to trees, plants and crops by living on or nibbling their roots. One of them, the *Cicada*, spends seventeen years as a larval form in the earth in the southern part of the United States. Many millipedes also live crawling in the soil. One of them, known as the superior wire-worm (1), does considerable damage. Then we have the earthworm which is perpetually wriggling its way through the soil, eating its way through it and extracting what organic matter it can get from the swallowed earth; and passing the indigestible remains in the form of worm castings on to the surface of the land. Darwin has estimated that these dried-up casts will raise the level of an acre of ground in England by one-tenth of an inch each year.

The soil, as we have seen, is simply teeming with life, while manured soil teems more. An investigation carried on at Rothamsted on two plots of ground, one of which had received no manure since the accession of Queen Victoria in 1837, and the other of which had received 14 tons of farmyard manure per acre, per annum, since 1843, showed that there were normally three times as many animals in the latter as there were in the former. In round numbers there were 15,100,000 invertebrates per acre, of which 7,720,000 were insects, in the manured plot. The corresponding numbers in the unmanured acre were 4,950,000, of which 2,470,000 were insects. The greatest number, both of insects and other invertebrates, occurred in the upper three inches of the soil; but there were exceptions to this. Most of the injurious insects such as the wire-worm, *Elater*, and the larvae of the daddy-long-legs, *Tipula*, were not affected materially by the manurial treatment of the plot. The invertebrata concerned consisted of larvae and imagos of all the principal groups of insects, many species of centipedes and millipedes and a certain number of spiders and of mites, many worms and round-worms and certain terrestrial crustacea, such as the wood-louse, and a number of snails were also found.

There are many other burrowing animals such as the marmot and the prairie dogs, the rabbit and the fox, but the most important of these in our country is the mole. This burrower displaces a very large quantity of earth. It works very hard, has a tremendous appetite, eats all manner of insect grubs, and will consume its own weight of earthworms in the course of twenty-four hours. It seems to work rather spasmodically, as the earth castings are ejected at periods of three hours.

(1) Another injurious animal, also unfortunately called a "wire-worm" is the larva of a beetle, *Elater lineatus*.

Now the effect of all these animals pushing and shoving through the soil is to open up passages for the air to enter, and the soil becomes aerated, and when rain comes these passages further convey water to the deeper layers of the earth. We have said that the soil is as teeming with life as a great city, and as regards the unicellular inhabitants there is the same sort of rhythm. The fall and rise in their number is comparable to that which a great city experiences when the number of the population is decreased by a Bank Holiday, or in the richer parts and more aristocratic quarters by the fatal habit of "week-ending." So numerous are these micro-organisms that it has been stated that "a single salt spoonful of soil will contain millions of organisms, some active, others in repose, and many in the form of spores."

BOOK NOTES

Herr Oswald Spengler's work "Der Untergang des Abendlandes" ("The Decline of Western Civilization") which is now being published in English is probably destined, says the *Saturday Review*, to take rank among that very small hierarchy of books—such as Adam Smith's "Wealth of Nations," and Kant's "Critique of Pure Reason"—which have stereotyped the current of the thought and opinion of an epoch. The author may be regarded, continues the above Journal, in the sphere of history as a parallel phenomenon to Dr. Einstein in the realm of physics and mathematics. His work should impart fresh direction to the whole of historical research. The book claims to predetermine history just as in science, research has determined the sequence of natural phenomena, and it will, in all probability, effect revolutionary progress in the realm of economic and social prognostication.

The South Sea Islands noted agriculturally for their large production of coconuts receive attention from an anthropological point of view in Sir James Frazer's second volume on Polynesian Beliefs. In this book reference is made to the great uniformity of the native culture which is indeed remarkable in a people scattered over so wide an an area in small and isolated communities and is a characteristic which is not observable in the case of the West Indies, for instance. Social organisation and language possess remarkable uniformity in these Pacific Islands and in economic pursuits the people are similar, cultivating the same staple plants—the coconut, bread fruit, sugar cane and taro. The main feature of Polynesian mentality is their belief in immortality. The antiquity of the culture in general should be emphasised, and the fact mentioned that the Polynesians were skillful gardeners and fishermen, talented and industrious artists, indefatigable builders of houses and boats and most adventurous sailors long before the advent of European discoverers.

COLLEGE RESEARCH

In the leading article of this number it is explained in general terms how the College is, in many respects, an evolutionary product of the Imperial Department of Agriculture for the West Indies. This relationship holds good particularly in respect of research; and although the present programme under the College regime is much more ambitious and comprehensive than it was in purely Departmental days, the work at present planned or in progress is, along certain lines, a continuation of former studies. Amongst these former studies must be mentioned Mr. W. Nowell's work on plant diseases, Dr. S. C. Harland's work on cotton breeding in St. Vincent, and the botanical and chemical studies of Dr. Mason and Mr. Hardy respectively—all of which have gained marked recognition in the best scientific and economic circles.

The present programme, as already stated, is much more comprehensive than ever existed formerly on account of staff augmentation and increased facilities and an entirely new outlook of the broadest Imperial type. Its only restriction is the limited nature of the funds available.

In the Department of Chemistry present work includes: (*a*) an investigation of the manufacture of calcium citrate and citric acid, (*b*) extraction of pectin from lime fruit rind, (*c*) methods of preparation of nicotine from tobacco, (*d*) physical characteristics of types of tropical colloidal soils on which work of fundamental importance has already been published.

In the Department of Economics the studies include: (*a*) a comparison of the cost of production of tropical produce in different stages of preparation (*b*) the formulation of cost accounting systems for cacao, coconut and rubber estates based on uniform principles and methods, (*c*) study of the economics of Trinidad and West African cacao industries, (*d*) study of tropical estate labour with reference to output, fatigue and efficiency.

In Entomology the following topics are receiving attention: (*a*) the relation of plant bugs to diseases of field crops, (*b*) studies in the inter-relation of plants and insects (such as the sugar-cane and the froghopper), (*c*) studies of insect association within the limits of a plant group, (*d*) the natural control of insect pests.

Mycological and bacteriological work includes (*a*) investigations of Panama wilt disease of the banana (*b*) studies of utilization of by-products (*e.g.* exhausted molasses), (*c*) studies of the fungi of internal boll rot of cotton, (*d*) saprophytic growth of Phytophthoras in soil.

The Department of Botany and Genetics has a wide range of studies in progress which cannot all be enumerated in the space available; but the work on cacao includes method of pollination, resistance to disease, possibility of combining fine quality of Criollo with heavy yield of Forestero and Calabacillo, that with cotton the isolation of a new type of Egyptian Jannovitch, that with coconuts, a study of the natural yield and the application of genetic methods to increasing yield, that with sugar cane, the breeding of a variety resistant to mosaic disease.

In the Department of Agronomy and Agriculture distance planting experiments are planned; agronomic trials of bananas, weed control experiments and the study of rotations are in progress.

COMMERCE AND TRANSPORT

In our desire to increase production and improve the efficiency of tropical estates by the application of those many branches of science and economics that are usually studied in agricultural colleges, we must never forget that most tropical produce has to be sent, as our cover illustrates, to overseas markets, which means the existence externally, that is, beyond the estate boundary, of a world of commerce and transport. This world of commerce and transport extends between the producer and the consumer and its characteristics under different conditions and circumstances vary widely.

In general trade activity these differences crystallise in the form of such items as cartage to the nearest port, freight charges, insurance, duties and brokerage. Examples where transport from the growing to the shipping centres are of extreme significance are to be found in East and West Africa, and we may take cacao transport on the Gold Coast and cotton transport in Nyasaland as specific instances. The cost of transport of one ton of cacao from Kadi in Akim Abuakwa to Accra, the chief Gold Coast port, is £10 15s. 5d.

Transport charges, however, are not necessarily determined by geographical distance, nor even by topographical differences. Sea transport varies with volume of trade, competition and other factors.

Duties often form a very important barrier between an estate and the ultimate consumers of that estate's produce. A high and permanent preference combined with geographical proximity has stimulated sugar production in Cuba and Porto Rico to its present enormous dimensions.

Merchants and brokers of tropical produce are important and generally useful figures in the estate's external world of commerce. They all take their toll, however, and it is desirable that the agriculturist should know what they do for it and how it is done—not always an easy thing to discover. There are definite trading cycles for different kinds of tropical produce which can be learnt with advantage, as can also be profitably examined the use and manufacture of different grades of raw material like rubber, cotton, cacao and hemp.

The essential point is that the agriculturist of the future must study the distribution of his produce as well as its production, and compare methods and costs in his region with those for similar produce in other places.

"The History and Present State of Scientific Research in the Dutch East Indies," Koninklijke Academie van Wentenschopper, Amsterdam, 1923, is a series of pamphlets (in English) prepared by the Royal Academy of Science of Amsterdam to summarize the development of various fields of pure and applied science in Java — geology, oceanography, meteorology, vulcanology, zoology, anthropology, botany. There is also a very interesting pamphlet entitled "A review of Chemical Industry in the Dutch East Indies," which forms a very full digest of the notable work that has been done by Dutch chemists engaged in the country mentioned in sugar cultivation and manufacture, and indigo, chincona, coffee, tea, rubber, tobacco, oil palm, rice and other industries.

REVIEWS

THE COCONUT PALM: The Science and Practice of Coconut Cultivation. By H. C. Sampson, C.I.E., B.Sc. London: Bale Sons and Danielson. Price £1 11*s.* 6*d.* net.

The author of the book was lately Director of the Madras Department of Agriculture so that his account deals mainly with conditions in Southern India, and particularly with cultivation on the Malabar Coast where the Department maintains a coconut station including a plantation of mature trees acquired in 1917. The sub-title indicates that the work is intended to appeal to both student and planter, and therefore challenges comparison with Copeland's well known work based on experience in the Philippines. It differs from Copeland's book by the absence of any systematic account of diseases and pests. On the other hand the first part which fills a third of the volume is devoted to a clear well-arranged elementary description of the parts of the tree and their gross internal structure—the best introductory account yet published from the student's standpoint. A considerable amount of original data is incorporated in this part. The remaining two parts deal with plantation management and products.

Southern India with its ancient, settled, civilised, and in parts, dense population and a long established coconut industry, provides conditions for an intense cultivation, and the author is all for that.

Necessary expense should not be spared in establishing vigorous and deep rooted trees and the plantation should be cultivated with plough and cultivator from the start.

The preparation of the sun-dried copra for which the Malabar coast is famous is described in detail and should furnish useful hints to some planters in the West Indies who are in a position to sun-dry their culls. Oil, coir, coconut-sugar and toddy (arrack if distilled) are all important products in South India and Mr. Sampson gives an interesting account of native methods. When the inflorescence is tapped by experts an acre of coconuts will yield as much sugar as a 40-ton crop of cane.

A characteristic of the book is the author's unassertive reliance on his own observations so that in matters where some writers are "large and vague" he is matter of fact and clear-cut and readable. The publishers have been generous in allowing forty plates—several in colour, large well spaced type and fine paper.

DISEASES OF CROP PLANTS IN THE LESSER ANTILLES. By W. Nowell, D.I.C. London: Published by the West India Committee on behalf of the Imperial Department of Agriculture for the West Indies. Price 12*s.* 6*d.* net.

This welcome book by the late Mycologist of the Imperial Department very effectively fills a gap in the literature of tropical plant diseases. In geographical range it covers, despite the title, the whole West Indian region, with the Guianas, and wisely includes adequate reference to a number of serious diseases of the more important crops not yet recorded from that region. The matter is handled in two parts—the first dealing in two sections with causation, prevention and control, and the second in three sections with general diseases and the special diseases of the individual permanent and arable crops. It has been written primarily for planters, students who look forward to becoming planters, and agricultural officers who are not specialists in plant pathology, so that technicalities have been spared though not lacking where they have seemed to be necessary. To avoid dubiety it may be said that the diseases treated of in this book are those caused by fungi, bacteria, infective viruses, parasitic flowering plants, nematodes, to which have been added certain diseases apparently of non-parasitic nature. The section on causations which contains a lucid and adequately full description of these groups is illuminated by a sense of the intimate relations existing between the crop, its parasites and the external conditions imposed by soil, climate and the management of the planter. This predominantly ecological standpoint enables the author to deal clearly and practically in the second part with the difficult class of "debility diseases" such as dieback of permanent crops and the root disease of sugar cane which as he points out, come prominently to the fore in the tropics where there is any falling off in good management from economic causes. In his account of the internal boll-rot of cotton, the red-ring disease of the coconut, and the black root diseases of permanent crops, Mr. Nowell writes with the authority of an investigator who has established their etiology and found effective methods of prevention and control.

The work closes with a select bibliography, a glossary of West Indian terms and an exhaustive index and it may be added is very free from typographical errors. As it is illustrated with 150 figures, mostly first-rate photographs, the price seems remarkably low and should promote a ready sale.

S. F. A.

The Leeward Islands (W. I.) with the help of an expert from Jamaica, continue to persevere with the production of tobacco which is principally made into cigars of fair quality which find a ready sale locally.

IN FIELD AND GARDEN

A new motor cultivator, known as the Rotary Soil Tiller, is giving satisfactory results in certain parts of the tropics. The machine, which is very compact and strongly constructed, is a Swiss invention and it performs excellent work tearing up grass and other weeds thereby producing a fine tilth at a depth of six inches. The work is done by strong spiral springs with hook attachments which rev ive at a high speed. The machine is 8-9 horse power, works on petrol and is not expensive to run. For orchard cultivation, where there are no stumps but plenty of short bottom grass this motor cultivator is to be highly recommended.

As is well known, live stock are used to keep down weeds to some extent ; cattle and sheep are extensively grazed in coconut plantations of mature age all through the tropics ; and we learn that on the Sumatra rubber estates, particularly in the native gardens, cows are used there to keep down the grass. Incidentally the animals in this part of the world make honeycombed paths over the land much of which is hilly and thus there becomes constructed cheap and practical terraces which prevent soil erosion. Which should remind us of the fact that cattle must receive credit for such work. The services rendered by cattle and the time lost by not fully employing them on estates needs to be more accurately accounted for than is the general practice at present.

Important work on bananas is now in progress at the Imperial College of Tropical Agriculture, the object being to obtain commercial varieties or strains resistant to Panama Disease. The Department of Agronomy has brought together a collection of 39 varieties and these will be added to as opportunity offers, and used as material for hybridization. A variety, known as Giant Fig, is reported from Grenada as giving promise in this direction. A bunch of the fruit, recently received was found to have certain very desirable characteristics as a good shipper—close, compact hands, with medium to large sized recurved fingers. This variety will be subjected to rigid tests in the trials just inaugurated. At the same time, it is hoped to obtain data bearing on the mode of suckering, best type of suckers for p anting and their relative fruiting values.

Concerning the planting of sugar cane, the Agronomy Department also reports that cuttings, 'n ands with heavy clay subsoil, are often seriously affected where the furrow method of planting is practised, as then, the cuttings are frequently planted in hard clay. A cheap and easy method, particularly when the rainfall is favourable, is to fill up the furrows with fairly well-rotted manure, placing the cuttings on, or inserting them into the manure, which is then covered by the mould from the adjoining banks.

RECENT CHEMICAL RESEARCH

VEGETABLE OILS AND LUBRICATION—Researches on lubrication have recently cleared up many of the debatable questions that have long occupied the attention of engineers. Much of the difficulty in the way of progress in lubrication problems has been due to the failure of engineers to recognise that there are two distinct kinds of friction. Heretofore, the accepted idea has been that lubricants act merely by interposing between the moving surfaces in contact, a film of oily substance whose component layers slide over one another. This theory, known as the Reynolds theory of lubrication, leads to the logical conclusion that the nature of the surfaces and the composition of the lubricant are of no account, provided that the latter possesses the degree of viscosity requisite for easy slipping.

Whilst the Reynolds theory appears to apply quite accurately to the majority of engine bearings, there are certain types of bearings (for example, worm gearing and bearings where the relative motion of the parts is of a reciprocating kind), to which the theory does not apply at all. In these cases, the contact between the surfaces is very intimate, and the thickness of a film of lubricant introduced between them possesses molecular dimensions. It has been shown by Mr. W. B. Hardy of Cambridge, England, that here the nature of the surfaces and the chemical composition of the lubricant are of paramount importance in deciding the degree of friction. Hardy demonstrated that certain fatty acids, such as are contained in animal and vegetable oils, are far more efficient than mineral oils in minimizing this so-called " boundary " friction.

The whole subject has been brought to the notice of engineers and to the oil industry by Dr. T. E. Stanton, Director of the National Physical Laboratory, London, in a lecture delivered to the International Air Congress, on June 29th, 1923. The results then announced explain why in certain cases the addition of but 1 per cent. of fatty acid to an ordinary mineral lubricant may reduce friction by as much as 17 per cent. and why the use of grooved surfaces, by maintaining a steady supply of lubricant to the sliding parts, may also aid in minimizing frictional forces.

In connection with tropical agriculture, the recent developments in the theory and practice of lubrication, will undoubtedly lead to a greater demand for vegetable oils. These contain fatty acids, but not all are suitable for lubrication purposes, however, since certain of them t nd to harden (" dry ") on exposure to air. Amongst the commoner non-drying vegetable oils, may be mentioned palm oil, palm nut oil, coconut oil, olive oil, peanut oil, and castor oil ; the inferior grades of these at least should find increasing employment in the manufacture of lubricants for certain kinds of machinery.

F. H.

COLLEGE NEWS

This month the laying of the foundation stone of the new College buildings will take place. A party of distinguished visitors from England will be present.

Sir Francis Watts and Professor H. A. Ballou, Professor S. F. Ashby and Professor S. C. Harland are attending the Agricultural Conference in Jamaica this month. The principal scientific topics on which papers are being read concern the cacao, coconut, sugar and banana industries.

This Session Dr. C. L. Withycombe, B.Sc., M.Sc., PH. D., formerly engaged in research work at the Imperial College of Science and Technology, was appointed Demonstrator in Zoology.

Mr. E. E. Cheesman, B.Sc., A.R.C.S., arrived on September 29, to take up his appointment as Demonstrator in Botany. Mr. Cheesman held a similar post at the Imperial College of Science and Technology.

Mr. P. E. Turner, B.Sc., A.I.C., who has been appointed Demonstrator in Chemistry will arrive early this year. Mr. Turner was Demonstrator in Chemistry at University College, Reading, and is now at Rothamsted Experimental Station taking a course in Agricultural Chemistry.

Captain H. V. Metivier, B.Sc., M.R.C.V.S., Government Veterinary Surgeon, Trinidad, will take up additional duties this year as lecturer in Veterinary Science.

This Session four post-graduate students, Messrs. J. C. Hopkins, A. B. Killick, N. S. Haig and G. W. Nye were sent out by the Empire Cotton Growing Corporation for special training in genetics and plant breeding.

Mr. J. C. Hopkins, B.Sc., who is specially interested in Mycology, was educated at Emmanuel School and King's College and spent one year at the Imperial College of Science and Technology studying Plant Pathology.

Mr. A. B. Killick, B.Sc., educated at Eastbourne College and S. E. Agricultural College, Wye, where he secured the Diploma, took a year's course in Plant Pathology and Physiology at the Imperial College of Science and Technology and is now specialising in Genetics and Plant Breeding.

Mr. N. S. Haig, B.Sc., who is taking a special course in Genetics and Plant Breeding spent one year at the Imperial College of Science and Technology studying Plant Physiology and Pathology. He was educated at Christ's Hospital and secured his Diploma at the S. E. Agricultural College, Wye.

Mr. G. W. Nye, B.Sc., educated at Forest School, and S. E. Agricultural College, Wye, securing his Diploma there in 1921, also spent a year at the Imperial College of Science and Technology studying Plant Physiology and Pathology and is now specialising in Genetics and Plant Breeding. At the University Farm at Christ's College, Cambridge where he spent a year, he assisted in hybridisation experiments.

These four students have recently been on a tour, visiting the cotton-growing islands of the West Indies to gain an insight into the experimental and plantation work being carried out in connexion with this industry. They left Trinidad on October 23, and are expected back about January 3.

In Barbados, Mr. J. R. Bovell, I.S.O., the Director of Agriculture, has been kind enough to assist in directing their studies.

In Montserrat the methods employed for combating the pink boll worm have been demonstrated, and an important item of interest was the results of the experiments in close spacing. In St. Vincent Mr. Burd's experiments in plant breeding were of special importance to these students.

Mr. R. Parga, B.A. (Rugby and Oxford) whose family owns extensive properties in Colombia, joined the College for post-graduate studies in cacao and live stock.

Mr. R.V. Grey from Sandhurst (England) joined the College on December 3, for the purpose of taking the Diploma course. There are now eighteen students taking this course at the College: seven from Trinidad, six from Barbados, one from Nevis, one from Jamaica, one from Montserrat and two from England.

Two former post-graduate students, Captain C. B. R. King, M.A., and Mr. E. S. Eldridge, who joined the College under the auspices of the Empire Cotton Growing Corporation, are now in Nyasaland.

Mr. A. Moody Stuart, B.A., who completed his studies in June, is now an overseer at the Usine Ste. Madeleine.

Two meetings of estate proprietors and managers took place at the College last term (November 8 and 28) in connexion with Professor Dunlop's work on costs of production and estate accounts. The following are those who attended: Sir Francis Watts, K.C.M.G. (the Principal), Hon. C. de Verteuil, C.M.G., Hon. A. B. Carr, Messrs. A. Kerr, A.C.A., L. de Verteuil, Cory Davies, Michael de Verteuil, Robert de Verteuil, Carl de Verteuil, jr., Jos. d'Abadie, R. Parga, B.A., J. d'Abadie, Mrs. William Gordon, Messrs. H. Hutton, W. Greig, G. Greig, A. Anderson, R. Johnson, L. Nivet, G. C. Skinner (General Manager of the Usine Ste. Madeleine), C. Forbes Todd, G. A. Jones, J. de Verteuil, M. de Meillac, and Frank Agostini.

The new prospectus (1924-25) has been prepared and is now in press. It differs materially from the previous ones in its outline of Diploma courses of study having a vocational trend in the Second and Third years.

Arrangements are in progress for the early erection of a complete sugar factory designed for teaching and experimental purposes. The machinery for this has been presented by the leading manufacturers of sugar machinery in the United Kingdom. The factory will be of a size sufficient to manufacture sugar on a small commercial scale and will, to a large extent, be operated by the students.

TREND OF THE MARKETS

[*It is desirable to inform readers that the notes below are based only upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications. Until the College develops its own statistical research and intelligence service the notes can only be in the nature of recent historical records. An attempt is made, however, to indicate the market feeling at the time of going to press, but we can assume no responsibility for the accuracy and subsequent truth of such observations.*]

SUGAR.—A rise above levels which were previously in the neighbourhood of 7 cents. (spot) New York for British crystals occurred at the end of last November and was followed by a decline to the previous level in December. On the 8th raw Cubas c. & f. remained steady at 5½ with May futures closing 4.75c. and July's at 4.81. The statistical position makes the outlook in respect of future prices for sugar promising rather than otherwise.

TEA.—A society paper in England has been bristling with scorn and indignation at the suggested substitute for tea, a fact which is of interest in respect of the strong demand-psychology existing in connexion with a commodity such as this. On both the produce and stock market, tea has been bouyant, though recently a reaction set in for the higher grades. Sumatra and Java sorts were less affected. Shipments of tea from the East were exceptionally heavy last year, indicating increased output. The average prices for teas during 1923 were approximately as follows: Ceylon 1*s.* 7*d.* per lb., North Indian 1*s.* 7*d.*, South Indian 1*s.* 6*d.*, Java 1*s.* 3*d.*, Sumatra 1*s.* 5*d.* These were 1*d.* to 2*d.* above what may be regarded as normal. Future outlook is good and is in some quarters strengthened by the belief that Russia will soon again be in the market for large quantities which will not be supplied by China as was the case before the war.

COFFEE.—In recent months coffee has been steady. Santos in London rose from 65*s.* per cwt. in August to 68*s.* in December. Higher grades 110*s.* Coffee in Trinidad has been selling readily at 16 cents per lb. The extension of coffee production in East Africa (Kenya) is proceeding and this country will become a large centre of supply in the future.

COPRA.—The price of this product has been rising steadily since last August and during the last month or two, good grades have been selling readily at £29 per ton, (spot) with palm kernels at £19 10*s.* (November-January delivery).

RICE.—Burmese in London rose from a level of £13 10*s.* per ton in August last to £16 10*s.* in October which was possibly connected with the Japanese earthquake. From October onwards prices became a little easier.

CACAO.—During the past three months cacao prices have fallen steadily. Trinidad mid-red dropped from 8½ cents per lb. (spot) New York to 7½ cents during last November. Owing to the U.S.A. purchases the relative value of Accra fermented rose; but a grade of cacao was being shipped from Lagos to New York at 29*s.* per cwt.—an exceedingly low figure. The difference in exchange is an inducement to the sale of cacao in New York and to some extent this partakes of the nature of a preference. The general outlook for cacao improved on December 18.

RUBBER.—The consumption of rubber in the United States fell off during the latter half of last year in spite of the greatly increased output of motor-cars, and consequently the price fell during the autumn though it is now showing a firmer tone. As is well known the declared object of the Stevenson restriction scheme has been to maintain the price of rubber at 1*s.* 3*d.* per lb. Over the whole twelve months, ending September, 1923, during which the scheme was first in force, the average daily buyer's price, spot, in London, of ribbed smoked sheet has worked out at 1*s.* 3·076*d.* per lb.

COTTON.—The last few months (particularly during November and December) has shown very high levels for fully middling cotton due to indications of great uncertainty of future supply. The rise in cotton has, in fact, been continuous since August and a feature has been the very high values for Sakel. Sea Island has been nominal. The outlook from the British spinner's standpoint is alarming.

SISAL.—In London recently prime sisal has been selling at about £35 10*s.* per ton c.i.f. with a tendency to rise. Manila hemp, Grade G, £37 15*s.* (Dec.–Feb.) Firm.

Essential oils from Citrus.—This industry is centred mainly round the Mediterranean basin and in the British West Indies. Italy is probably the largest producer of essential oils of citrus fruits, the production in 1920 (latest available statistics) being 889,500 kg. and including 635,690 kg. of lemon oil and 111,170 kg. of bergamot oil. Neroli oil is produced in Algeria, and certain amounts are produced in France and Spain. Dominica and other islands of the Leeward Island group produce lime products as well as orange oil. Imports of citrus oils into Great Britain totalled 2,014,325 lb. in 1921. The consumption in the United States is increasing, imports of lemon oil alone having risen from 450,000 lb. before the war to nearly 700,000 lb. in 1922. It is reported that the industrial distillation of citrus oils is being established in Southern India in Mysore.—(*U. S. Comp. Rep.*, May 14, 1923, *Journ. Soc. Chem. Ind.*, September 14, 1923.)

The production of coconut and peanut oil in Holland has enormously increased since pre-war days. The number of metric tons of coconut oil manufactures was 10,602 in 1913; 43,823 in 1919; 45,672 in 1920; and 64,942 in 1921.